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# Enhancing Chemistry Learning through Digital Platforms: Teachers' Practices and Students' Engagement in Morogoro Secondary Schools, Tanzania

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**Abstract:** The study examined the influence of digital learning platforms on students' understanding and application of Chemistry concepts in public secondary schools in Morogoro, Tanzania. It aimed to explore the types of digital platforms employed by teachers, assess the extent of their classroom integration, and evaluate their effects on students' learning outcomes. A mixed-methods approach was used, combining questionnaires, interviews, lesson plan analysis, and classroom observations. Data were collected from 52 students, 10 Chemistry teachers, and school administrators across selected schools. Findings revealed that while teachers demonstrated high awareness of digital learning platforms and frequently used them during lesson preparation, classroom integration remained inconsistent. Students reported partial exposure, with only 52% observing the use of digital tools during lessons. Teachers predominantly relied on user-friendly resources such as YouTube educational channels and national online platforms (Shule Direct, TIE, Mwalimu Plus), whereas sophisticated Learning Management Systems were minimally utilized. Observations and student feedback highlighted positive effects of digital platforms on conceptual understanding, problem-solving, visualization of abstract concepts, engagement, motivation, and collaborative learning. Challenges included limited infrastructure, unreliable internet, inadequate technical support, and underutilization of advanced digital tools. These findings align with the Technology Acceptance Model (TAM) and TPACK framework, emphasizing the need for both perceived usefulness and ease of use, along with pedagogical integration, to optimize digital learning. The study recommends enhancing infrastructure, providing continuous professional development, promoting LMS adoption, and fostering institutional policies that support systematic digital integration in Chemistry instruction to maximize learning outcomes.

**Keyword :** Digital learning platforms, Chemistry education, secondary schools, ICT Integration, student engagement, Tanzania

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## Introduction

Chemistry is widely regarded as the "central science" because it bridges other scientific disciplines, including physics and biology, and underpins many careers in STEM fields such as medicine, engineering, and environmental science (Brady & Senese, 2020; Holme & Murphy, 2018). Mastery of chemistry concepts is essential for

academic progression, yet it remains one of the most challenging subjects due to its abstract nature, mathematical complexity, and the need for practical experimentation (Ali, 2012). Traditional teaching approaches in Tanzanian secondary schools often rely on teacher-centered methods and textbooks, which have been found insufficient in fostering deep understanding and active engagement (Tilahun & Tirfu, 2016). In response to these challenges, digital learning platforms including virtual laboratories, learning management systems, and mobile-based applications have emerged as transformative tools that offer interactive, visual, and experiential learning opportunities, enabling students to explore complex chemistry concepts in ways not possible through conventional instruction alone (Manyilizu, 2023; Maier et al., 2022).

Globally, the integration of digital learning platforms has demonstrated positive impacts on student comprehension, performance, and motivation in science education. Studies in the United States, Pakistan, and Taiwan indicate that students who engage with virtual labs, animated simulations, and interactive exercises perform better academically and retain knowledge more effectively compared to peers taught through traditional methods (NCES, 2022; Noor et al., 2022; Lin et al., 2017). However, the effectiveness of these tools depends heavily on teachers' technological competence and their ability to integrate digital resources into pedagogy (Hadiana et al., 2024). In African contexts, including Tanzania, adoption of digital learning is advancing but constrained by infrastructure deficits, digital literacy gaps, and socio-economic disparities (Shisakha et al., 2024; Olanrewaju et al., 2021). Government and private initiatives, such as Shule Direct, TzShule, Learning Hub Tanzania, and programs expanding electricity access and distributing tablets, aim to promote digital learning, yet barriers persist in ensuring equitable access and effective pedagogical use (Niamen, 2020; MoEST, 2024).

In Tanzanian secondary schools, chemistry instruction continues to face practical challenges, including insufficient laboratory facilities, overcrowded classrooms, and limited instructional resources (Kisanga & Ireson, 2015). While digital platforms offer opportunities for simulation-based experiments, interactive visualizations, and online tutorials, their integration remains minimal due to unstable internet, inadequate devices, and limited teacher training (Malekani, 2018; Lubua, 2023). Consequently, there is little empirical evidence on the actual influence of digital learning tools on students' understanding of complex chemistry concepts. This study therefore explores how digital learning platforms impact students' engagement, comprehension, and application of chemistry concepts in public secondary schools in Morogoro Municipality. The findings are expected to provide insights to improve digital teaching practices and strengthen chemistry education in Tanzania.

**Research Objective**

1. To identify the types of digital learning platforms used by Chemistry teachers and the extent of their integration into classroom instruction.
2. To assess the effects of digital learning platforms on students' understanding, problem-solving abilities, and application of Chemistry concepts.

**Literature Review**

**1. Theoretical Review**

This study is grounded in two major theoretical frameworks that guide the understanding of digital learning integration in chemistry education. The first is the TPACK (Technological Pedagogical Content Knowledge) framework, which emphasizes the interplay between technology, pedagogy, and content knowledge to achieve effective teaching (Mishra & Koehler, 2006). In the context of chemistry, TPACK enables teachers to integrate digital tools that simplify complex concepts, enhance conceptual understanding, and strengthen inquiry-based learning. The second framework is the Technology Acceptance Model (TAM), developed by Davis (1989), which posits that technology use is influenced by Perceived Usefulness (PU) and Perceived Ease of Use (PEU). According to TAM, students and teachers are more likely to adopt digital learning platforms when they perceive them as beneficial for learning and easy to operate, highlighting the importance of user perceptions in shaping technology integration. Together, these frameworks provide a theoretical lens for examining how digital platforms can influence both instructional practices and student learning outcomes in chemistry.

**2. Empirical Review**

Despite the growing global adoption of digital learning platforms, there remains a significant gap in understanding their subject-specific impact, particularly on chemistry students in secondary education. While studies such as Kafyulilo et al. (2015) have highlighted the general benefits of digital platforms, they have not explored their direct influence on chemistry performance. Existing research underscores the positive effects of digital tools on student engagement and achievement. For instance, Sappaile et al. (2023) examined 500 students in Bandung, Indonesia, and found that digital learning platforms accounted for 25% of the variance in academic achievement, with student engagement contributing an additional 15%. Similarly, Smith et al. (2020), in a meta-analysis of 25 studies, reported a 15% improvement in science subject performance among students using platforms such as Moodle and Edmodo. Digital tools also play a role in fostering early interest in chemistry and supporting foundational learning; for example, Lubua (2023) demonstrated that educational television content, including storytelling, songs, and animations, effectively teaches STEM concepts in an enjoyable and relatable manner.

Moreover, digital platforms eliminate geographical barriers, enabling access to learning content from anywhere with an internet connection (World Bank, 2020), and provide opportunities for teacher professional development and personalized instruction (Maier et al., 2022).

In the Tanzanian context, research on digital learning platforms has primarily focused on higher education, leaving secondary schools largely underexplored. Studies by Nassary and Kitula (2024) and Lashayo and Johar (2017) indicate positive learning outcomes in higher education, but the impact on secondary school students, particularly in chemistry, remains largely unknown. Additionally, while some studies address general ICT adoption challenges in secondary schools (Mwajuma et al., 2021), few examine how specific platforms, such as virtual labs and learning applications, affect chemistry learning outcomes. Most prior research has concentrated on pedagogical effectiveness rather than addressing subject-specific challenges like mastering abstract concepts or conducting experiments virtually (Mtebe et al., 2020). This study aims to fill these gaps by assessing the influence of digital learning platforms on chemistry students' performance in secondary schools in Morogoro, providing deeper insights into how such tools can enhance learning outcomes and overcome subject-specific challenges.

## Methodology

A mixed-methods design was used, integrating quantitative and qualitative techniques (Creswell as applied in Kasanda & Kanyongo, 2020). A sample of 100 students, 10 Chemistry teachers, and 5 school administrators was drawn from five government secondary schools in Morogoro using purposive and stratified sampling. Data collection tools included questionnaires, interviews, and classroom observations. Quantitative data were analyzed using descriptive statistics, while qualitative data were thematically analyzed to identify emerging patterns (Ngessa & Sanga, 2020).

## Result and Discusion

### Presentations of Findings

#### 1. Types of Digital Learning Platforms Used by Chemistry Teachers on Increasing Students' Ability to Understand Chemistry Concepts

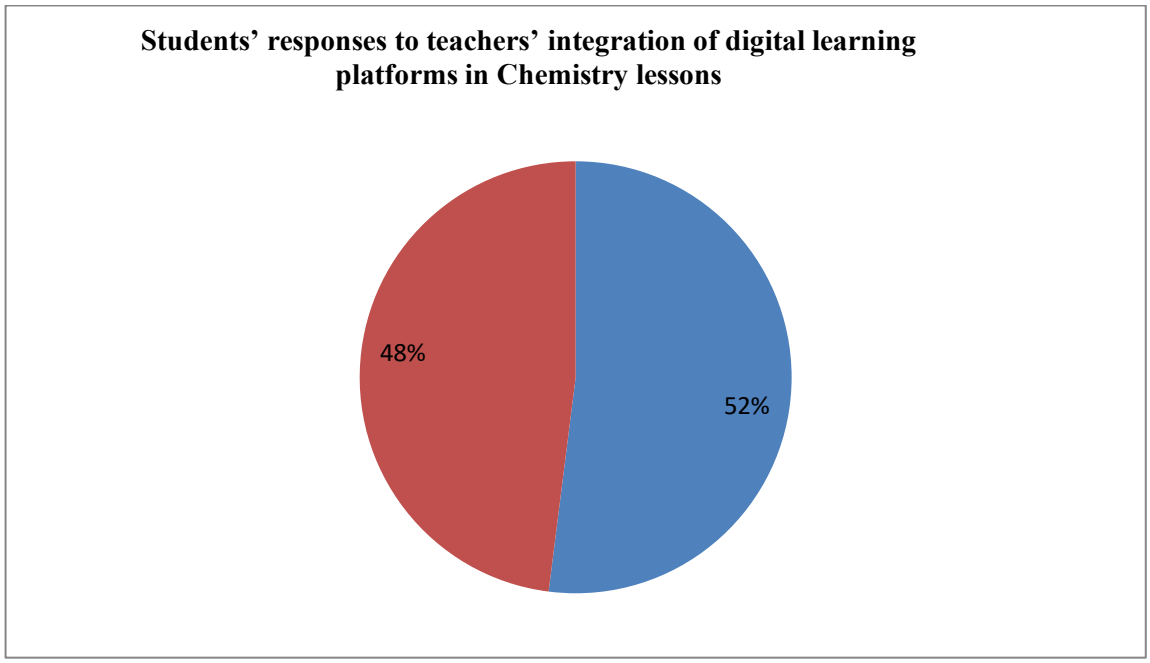
The first objective of the study was to explore the types of digital learning platforms employed by Chemistry teachers to improve students' comprehension of Chemistry concepts. Data were collected from students, teachers, and school administrators to assess their awareness, usage patterns, and the extent to which these platforms have been integrated into teaching and learning. The focus was on identifying not only the categories of platforms in use but also the degree to which they are incorporated into classroom practice.

**a. Awareness of the use of digital platforms in learning chemistry Student's awareness**

This section examines students' awareness of the use of digital platforms for learning chemistry in the study area. The results presented in Figure 1, based on responses from students regarding their teachers' integration of digital learning platforms in the classroom, show that 52% of students reported that their teachers utilized these platforms, while 48% indicated that they had never observed such usage.

The findings highlight that the integration of digital learning platforms in chemistry classrooms has only been partially achieved. Although slightly more than half of the teachers are using digital platforms, the nearly equal proportion of students who have not experienced such practices suggests that digital learning has not yet been fully mainstreamed across schools. This is also supported by Mtebe & Mbwilo ( 2021) in the study on e-learning uptake in Tanzanian universities which revealed that only a small proportion of students and academics were aware of and actively using digital platforms. Specifically, awareness was reported at **16%,** with attitude, accessibility, and availability of e-learning resources all remaining below 30%.

This inconsistency reflects unequal adoption and raises concerns about the adoption of digital learning platforms with Tanzania National education objectives.




Source: Field Data, 2025.

**Figure 1.**
**Students Responses on Teachers' Integrations of Digital Learning Platforms in Classroom**

Findings from student responses indicated mixed awareness regarding the integration of digital learning platforms into Chemistry classrooms. As illustrated in Figure 1, slightly more than half of the students (52%) reported that their teachers utilized digital platforms in their lessons, while 48% stated that they had never observed such practices. These results suggest that the adoption of digital learning platforms remains inconsistent across schools. Although some students benefit from exposure to digital tools, a significant proportion of learners are still reliant on traditional approaches, raising concerns about equitable access to digital-supported learning.

This partial integration aligns with the findings of Mtebe and Mbwilo (2021), who noted that in Tanzanian higher learning institutions, only a small proportion of students and academics actively used e-learning resources, with awareness levels as low as 16% and access to digital resources below 30%. Such parallels highlight that the challenges of awareness and integration are not confined to universities but also persist in secondary education. The limited adoption in Chemistry classrooms underscores a gap between Tanzania's educational objectives, which emphasize ICT in pedagogy, and the realities of classroom practice.

**b. Teachers' Awareness**

Contrary to the students' perceptions, all Chemistry teachers (100%) reported being aware of digital learning platforms and acknowledged their importance in supporting instruction. Teachers also indicated that they frequently used digital platforms during lesson preparation, for example in sourcing online materials, simulations, or references. However, students' accounts revealed that this awareness does not necessarily translate into classroom application. Nearly half of the students (48%) reported never witnessing their teachers employ these platforms in actual Chemistry lessons. This discrepancy suggests that teachers' engagement with digital platforms is skewed towards preparation rather than interactive instruction, thereby limiting students' direct exposure to digital learning experiences.

**c. Administrators' Awareness**

Interviews with school administrators further reinforced this observation. While administrators acknowledged that teachers were generally aware of and sometimes used digital learning platforms, they emphasized that actual classroom application was minimal. One administrator remarked that although teachers often included online references in their lesson plans, they rarely displayed videos, animations, or other interactive digital resources in classrooms. This finding reveals a gap between teachers' awareness and practice, echoing students' perspectives.

Administrators attributed the limited classroom integration not to a lack of awareness, but to structural and pedagogical barriers. Among the key challenges

identified were inadequate infrastructure, such as unreliable internet access, shortage of projectors, insufficient technical support, and teachers' reluctance to abandon conventional chalk-and-talk methods. Despite these barriers, administrators maintained that digital platforms hold significant potential to transform Chemistry education if effectively mainstreamed. They emphasized that consistent support, investment in infrastructure, and teacher training are crucial for moving from awareness to practical application.

The findings indicate that awareness of digital learning platforms is high among teachers but uneven among students, with actual classroom integration lagging behind. This gap reflects a broader issue identified in both national and international studies: the presence of digital tools and awareness does not guarantee their effective use in teaching and learning (Mtebe & Mbwilo, 2021; UNESCO, 2020). For Chemistry, where abstract concepts often require visualizations, simulations, and interactive exercises, the limited classroom use of digital platforms restricts opportunities for deeper understanding. Unless systemic barriers such as infrastructure, technical support, and teacher attitudes are addressed, the potential of digital learning platforms will remain underutilized in enhancing Chemistry learning outcomes.

**2. Types of Digital Learning Platforms Used by Chemistry Teachers on Increasing Students Ability to Understand Chemistry Concepts.**

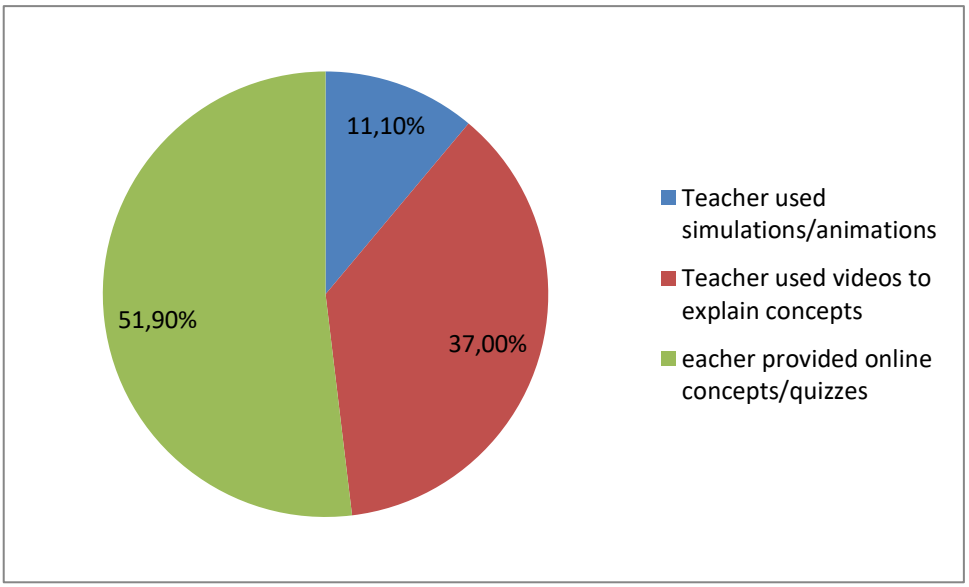
The study sought to identify the types of digital learning platforms utilized by Chemistry teachers, including YouTube educational channels, online learning platforms such as Shule Direct, the Tanzania Institute of Education (TIE) platform, and Mwalimu Plus, as well as Learning Management Systems (LMS). The findings revealed that all teachers (100%) reported using YouTube educational channels and national online learning platforms (Shule Direct, TIE, and Mwalimu Plus) to support the teaching of Chemistry. In contrast, only 20% of teachers indicated that they used LMS.

These findings suggest that Chemistry teachers predominantly rely on easily accessible digital resources such as YouTube and Tanzanian online learning platforms to enhance students' understanding of Chemistry concepts. The limited adoption of LMS may reflect challenges such as inadequate training, lack of institutional support, or low familiarity with their features, despite the potential of LMS to organize learning resources, track learner progress, and provide interactive learning opportunities (Ifenthaler & Yau, 2020)

On other hand Data collected from 52 students who reported that they have seen their teachers utilize digital learning platforms, as shown in Figure 2 below, revealed that only 11% reported their teachers used simulations and animations to explain difficult concepts in the classroom. In contrast, 37% indicated that teachers

used videos for instructional purposes, while a significant 52% noted that teachers provided online concepts and quizzes.

These results suggest that teachers' use of digital platforms is based toward less technical, more user-friendly resources such as videos and quizzes, which are often sourced from YouTube or online learning platforms. While the learning Management System remain back due to its less popularity and easiness to use




Source: Field Data, 2025.

**Figure 2.**
**Students responses on teachers' use of digital learning platforms in classroom**

In addition data collected from teachers lesson plans revealed that 90% of teachers integrate the use of digital platforms during preparations of the Chemistry lessons but only 50% reported to present these videos and animations to classrooms. Among these the researcher observed that the mostly digital platforms used by the teachers were online learning platforms which teachers surf materials and download notes and quizzes. Teachers also uses YouTube videos to observe some complex chemical reactions so as can be able to present in classrooms, the use of learning management system was observed by only 2 teachers out of 10. This observations needs to raise awareness to education systems about the use of LMS since it is very useful.

### 3. Frequencies on the Use of Digital Learning Platforms

The responses from teachers in table 1 indicate that while 30% reported using digital platforms very often and another 30% often, a larger proportion (40%) admitted they rarely use them in their teaching in classroom. The results show although there is some level of adoption, the use of digital platforms in Chemistry classrooms remains

inconsistent. The researcher highlights a gap between the potential of digital learning platforms and their actual application.

**Table 1.**
**The Frequency of Use of Digital Platforms to Teachers in Classroom**

| Frequency | Percent (%) |
|---|---|
| Very Often | 30.0 |
| Often | 30.0 |
| Rarely Often | 40.0 |
| **Total** | **100.0** |

Source: Field Data, 2025.

## 4. Digital Devices Used by Teachers

**Table 2. Digital Devices Used by Teachers in Classroom**

| Digital Devices | Frequency Percentage (%) |
|---|---|
| Smartphone as a digital learning device | 100 |
| laptop as a digital learning device | 30 |
| Tablet as a digital learning device | 70 |

The analysis of digital devices used by teachers in in table 1 classrooms reveals that smartphones (100%) and tablets (70%) were the most commonly reported devices used by teachers, this shows that although some teachers may personally rely on smaller, more accessible devices such as smartphones and tablets, these tools are often not effectively integrated into classroom instruction in a way that is visible or beneficial to students as a results teachers decided to use digital materials during lesson preparations and ignoring during lesson presentations.

The findings of this objective indicate that Chemistry teachers in the study area demonstrate high levels of awareness regarding digital learning platforms, with 100% acknowledging their value for lesson preparation. However, awareness has not translated into consistent classroom application, as nearly half of the students reported that they had never observed teachers using such tools during lessons. This gap between knowledge and practice echoes earlier findings by Mtebe and Mbwilo (2021), who revealed similarly low uptake of e-learning in Tanzanian universities, attributing the challenge to issues of accessibility, infrastructure, and attitude. In this context, the Technology Acceptance Model (TAM) helps explain the observed inconsistency: teachers may recognize the perceived usefulness of digital platforms but face challenges with perceived ease of use due to infrastructural barriers such as unreliable internet, lack of projectors, and limited technical support. As TAM suggests, without

addressing both perceived usefulness and ease of use, adoption of technology remains superficial rather than transformative.

In terms of platform types, the study found that teachers predominantly relied on accessible resources such as YouTube and Tanzanian online platforms like Shule Direct, TIE, and Mwalimu Plus, while more sophisticated tools such as Learning Management Systems (LMS) were used by only 20% of teachers. Similarly, students reported that most teachers used digital platforms to provide online quizzes (52%) and videos (37%), with simulations and animations tools that could better visualize abstract Chemistry concepts being used by only 11%. These findings align with Ifenthaler and Yau (2020), who observed that teachers often gravitate toward simpler, user-friendly platforms, leaving advanced tools underutilized. This reliance on "lighter" forms of technology points to a comfort zone that limits deeper integration of ICT into pedagogy. The Policy Implementation Theory is relevant here, as it highlights the gap between policy-level promotion of ICT integration in education and the weak institutional capacity that prevents teachers from effectively utilizing more robust systems such as LMS.

The frequency and device-use data further emphasize the inconsistencies in digital adoption. While 60% of teachers reported using platforms "often" or "very often," 40% admitted to rarely using them, showing uneven application. Smartphones (100%) and tablets (70%) were the most common digital devices used by teachers, whereas laptops were less frequently employed (30%). This indicates that teachers depend on personal devices that may not be well-suited for classroom delivery, explaining why much of their ICT use remains confined to lesson preparation rather than interactive teaching. UNESCO (2020) similarly highlighted that African educators often use mobile devices for preparation but struggle to incorporate them into classroom practice due to infrastructural and pedagogical barriers. These findings reinforce the importance of aligning institutional investments with teacher training and support so that digital platforms are not only available but effectively integrated into classroom teaching. Without deliberate policy enforcement and resource allocation, the promise of digital learning platforms in enhancing Chemistry education will remain underutilized.

## 5. Effect of Digital Learning Platforms on Students' Ability to Understand and Apply Chemistry Concepts.

The second objective of this study was to analyze the effects of digital learning platforms on students' ability to understand and apply Chemistry concepts. Quantitative data were obtained from questionnaires administered to students and Chemistry teachers, while qualitative insights were collected through interviews with school administrators. Also observation checklist were used to observe changes in classroom interactions before and after use of digital learning platforms this helped

directly to observe the effect of digital learning platforms on students understanding of chemistry concepts.

**a. Students Views on the Effects of Digital Learning Platforms on Students Learning**

The findings from students indicate that digital learning platforms exert a strong positive influence on students' comprehension and application of Chemistry concepts in public secondary schools in Morogoro. As shown in Table 3, a large proportion of students (92%) agreed or strongly agreed that digital platforms enhance their understanding of Chemistry concepts. Similarly, 86% of the respondents reported that online resources improve their problem-solving ability, while 90% stated that digital tools make the learning process easier. Furthermore, 92% highlighted that the use of videos and animations enhances visualization of complex Chemistry processes, a finding consistent with the role of visual simulations in facilitating comprehension of abstract scientific phenomena.

The results further revealed that digital platforms support flexibility in learning, with 88% of students appreciating the opportunity to review topics at their own pace. This aligns with literature emphasizing the role of digital platforms in providing personalized and self-directed learning opportunities. In addition, students reported positive motivational outcomes, with 88% acknowledging that digital tools increased their interest in learning Chemistry and 80% affirming that such tools enhanced their confidence. Importantly, 86% of the respondents agreed that online quizzes and learning platforms contributed to the improvement of their grades, suggesting that digital resources may play a critical role in formative assessment and performance monitoring.

Despite these positive outcomes, some challenges were also identified. Approximately 16% of students admitted being distracted when using digital resources, while between 6% and 8% reported feeling confused or perceiving online lessons as a waste of time. Nonetheless, the majority of learners strongly disagreed that digital learning makes Chemistry confusing (78% strongly disagreed, 22% disagreed) or that it fails to support application of knowledge (68% strongly disagreed, 18% disagreed). These findings suggest that although digital platforms are highly effective in supporting learning, a minority of students face difficulties linked to distractions, limited digital literacy, or inadequate teacher scaffolding during online learning.

Taken together, the findings imply that digital learning platforms have the potential to significantly enhance the quality of Chemistry education in Tanzania by improving conceptual understanding, applying theoretical knowledge practically, helping to solving different chemistry tasks, making revision, supporting flexible and self-paced learning, and boosting student motivation and confidence. The findings also supported by Research conducted by Sappaile, B., et al. (2023) which reported

high a positive correlation between the utilization of digital learning platforms and student engagement, as well as a favorable impact of student engagement on academic performance .

However, their effectiveness is not uniform across all learners, as challenges related to distraction, guidance, and digital competency persists. Addressing these limitations through teacher support, structured integration of digital resources, and digital literacy training may maximize the benefits of digital platforms in Chemistry instruction.

**Table 3. Students responses on the effect of Digital learning platforms**

| SN | Effects of Digital learning platforms on students learning Chemistry | Strongly Disagree | | Disagree | | Undecided | | Agree | | Strongly Agree | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | F | % | F | % | F | % | F | % | F | % |
| 1 | Digital learning platforms help me understand Chemistry concepts better. | 2 | 2 | 4 | 4 | 2 | 2 | 22 | 22 | 70 | 70 |
| 2 | Online resources improve my ability to solve Chemistry problems. | 2 | 2 | 4 | 4 | 8 | 8 | 28 | 28 | 58 | 58 |
| 3 | I find learning Chemistry easier when I use digital learning platforms. | 2 | 2 | 4 | 4 | 4 | 4 | 32 | 32 | 58 | 58 |
| 4 | Videos and animations help me visualize Chemistry concepts clearly. | 2 | 2 | 4 | 4 | 6 | 6 | 36 | 36 | 56 | 56 |
| 5 | Digital learning platforms allow me to review Chemistry topics anytime. | 4 | 4 | - | 0 | 8 | 8 | 34 | 34 | 54 | 54 |
| 6 | I feel more confident in Chemistry because of digital learning tools. | 2 | 2 | 4 | 4 | 14 | 14 | 36 | 36 | 44 | 44 |
| 7 | Using online quizzes helps me apply Chemistry knowledge better. | 4 | 4 | 4 | 4 | 10 | 10 | 30 | 30 | 52 | 52 |
| 8 | Digital learning motivates me to study Chemistry more. | 4 | 4 | 2 | 2 | 6 | 6 | 38 | 38 | 50 | 50 |
| 9 | I believe digital platforms are effective in improving my Chemistry grades. | 4 | 4 | 8 | 8 | 2 | 2 | 44 | 44 | 42 | 42 |
| 10 | Digital learning platforms make Chemistry more confusing for me. | 56 | 56 | 22 | 22 | 10 | 10 | 6 | 6 | 6 | 6 |
| 11 | I often get distracted when using online Chemistry resources. | 46 | 46 | 30 | 30 | 8 | 8 | 14 | 14 | 2 | 2 |
| 12 | I feel lost when using digital tools for Chemistry. | 70 | 70 | 22 | 22 | 2 | 2 | 4 | 4 | 2 | 2 |
| 13 | Online Chemistry lessons waste my study time. | 66 | 66 | 22 | 22 | 6 | 6 | 2 | 2 | 4 | 4 |
| 14 | Digital learning does not help me apply Chemistry concepts well. | 68 | 68 | 18 | 18 | 8 | 8 | 2 | 2 | 4 | 4 |

Source: Field Data, 2025.

## 6. Teachers' Views on the effect of Digital Learning Platforms in Chemistry learning

The findings in Table 3 reveal that teachers strongly believe digital learning platforms play a key role in enhancing students' understanding of complex Chemistry concepts. All teachers (100%) agreed that students understand Chemistry concepts better when taught through digital platforms, with 70% strongly agreeing.

Teachers particularly emphasized the importance of visual resources such as videos, animations, and simulations, with 70% strongly agreeing and 30% agreeing that these tools significantly improve students' comprehension of difficult Chemistry

content. This highlights the value of digital platforms in simplifying abstract concepts like molecular structures, chemical bonding, or reaction mechanisms which are often challenging to explain using traditional methods.

Additionally, 70% of teachers agreed and 30% strongly agreed that digital platforms help in explaining abstract or complex Chemistry ideas, further confirming that technology provides alternative approaches to tackling learning difficulties in science. The use of simulations and interactive applications was seen as essential in bridging the gap between theory and practice.

Teachers also noted that students are more engaged when digital platforms are used (100% strongly agree). Increased engagement is particularly significant for complex topics where sustained attention and visualization are necessary for mastery. Furthermore, the majority of teachers (70% agree; 30% strongly agree) indicated that digital platforms contribute to improved performance in Chemistry tasks, suggesting that deeper understanding translates into better academic outcomes.

However, when asked about specific online platforms such as Shule Direct and TIE, 30% of teachers remained undecided. This indicates that while the potential of digital platforms to enhance understanding is well recognized, there may be gaps in terms of awareness, accessibility, or practical integration of localized e-learning resources in schools.

**Table 4. Teachers Responses on the Effect of Digital Learning Platforms**

| Sn | Teachers response on effect of digital learning platforms on students ability to understand and apply chemistry concepts | Strongly disagree | Disagree | undecided | agree | Strongly agree |
|---|---|---|---|---|---|---|
| 1 | Students understand Chemistry concepts better when taught using digital learning platforms | | | | 3 | 7 |
| 2 | Visual resources (e.g., videos, animations) improve students' comprehension of Chemistry | | | | 3 | 7 |
| 3 | Digital learning platforms help in explaining abstract or complex Chemistry ideas. | | | | 7 | 3 |
| 4 | Students are more engaged during Chemistry lessons that involve digital learning platforms. | | | | | 10 |
| 5 | Students perform better in Chemistry tasks after using digital learning platforms | | | | 7 | 3 |
| 6 | Online platforms such as shule direct, TIE, etc support students in applying theoretical knowledge to practical tasks. | | | 4 | 3 | 3 |
| 7 | Students' confidence in solving Chemistry problems has improved due to the use of digital learning platforms. | | | | 7 | 3 |
| 8 | Students are able to transfer knowledge gained from digital learning content into classroom activities. | | | | 7 | 3 |
| 9 | Digital learning resources help students revise and retain Chemistry content better | | | | 7 | 3 |

Source: Field Data, 2025.

Interviews with school administrators further revealed that the integration of digital learning platforms has a significant influence on students' interest in Chemistry. Administrators observed that students demonstrate higher levels of

engagement and motivation when lessons incorporate digital tools. One school administrator explained:

> *"Mostly students like to observe new things and are quite interested when there are a lot of activities in class. Engaging digital learning platforms in Chemistry will help students to even observe practical which are not taught in class. So my advice to Chemistry teachers is to please engage these digital learning platforms in the classroom not only use them during preparation of the subject but also during classroom presentations."*

These views suggest that administrators associate the use of digital learning platforms with increased student motivation, deeper engagement, and enhanced understanding of Chemistry concepts, particularly through exposure to practical demonstrations that may otherwise be unavailable in school settings. This highlights administrators' recognition of the positive pedagogical effects of digital platforms and their call for teachers to actively integrate them into classroom teaching rather than limiting their use to lesson preparation.

**a. Observation Checklist Views on Students' Behavior**

The observation checklist revealed significant positive behavioral changes among students after the integration of digital learning platforms in Chemistry lessons. Before the use of such platforms, only a few students demonstrated active engagement, such as revisiting or reviewing content, working in groups, or assisting their peers. However, after the introduction of digital platforms, most students were observed engaging in these activities, suggesting that digital tools created opportunities for deeper interaction with content and more collaborative learning. This highlights the potential of digital platforms to transform passive learners into active participants by providing interactive and stimulating learning experiences. Summary data is presented in Table 8

**Table 5. Observation of Students' Behavior Before and After Using Digital Learning Platforms**

| Indicator | Before Digital Learning | After Digital Learning | Observed Change |
|---|---|---|---|
| Revisiting or reviewing content | Few students | Most students | Increased engagement with content |
| Working effectively in groups | Few students | Most students | Improved collaboration |
| Sharing ideas or assisting peers | Few students | Most students | Enhanced peer interaction |

| | | | |
|---|---|---|---|
| Respecting and cooperating in group activities | Few students | Most students | Improved respect and cooperation |
| Motivation, curiosity, and enthusiasm | Low | High | Increased motivation and enthusiasm |
| Focus and attention throughout the lesson | Low | High | Improved concentration and attention |

Source: Field Data, 2025.

The researcher recorded observable changes in students' behavior before and after the integration of digital learning platforms in the classroom. The observation focused on how digital tools influenced students' learning behaviors and their understanding of Chemistry concepts, specifically during the study of the electrolysis of copper using copper electrodes. The study involved Form Three students and was conducted in two scenarios: first, when the topic was taught using conventional methods without digital resources, and second, when videos and animations were integrated into the lesson to enhance explanations.

As shown in Table 5, notable behavioral differences were recorded between the two approaches. Before the use of digital platforms, only a few students revisited or reviewed content, worked effectively in groups, or shared ideas with their peers. Motivation, curiosity, and attention levels were also observed to be low. However, after integrating videos and animations, most students actively engaged with the content, frequently revisited learning materials, and collaborated more effectively in groups. Peer interaction improved significantly, with many students assisting one another and showing greater respect and cooperation during group tasks. Furthermore, motivation and enthusiasm increased markedly, with students demonstrating sustained focus and curiosity throughout the lesson.

These findings highlight that digital learning platforms promote active engagement, enhance peer collaboration, and foster positive attitudes toward learning. For instance, the observed increase in respect, cooperation, and group participation indicates that digital tools not only support content mastery but also encourage the development of interpersonal skills critical for holistic learning. This interpretation aligns with Manyilizu (2023), who, in a study conducted in Dodoma, found that students who engaged in virtual laboratories prior to hands-on experiments demonstrated superior performance and a deeper understanding of chemical concepts compared to those using traditional paper-based approaches.

**Discussion of Findings**

The findings of this study reveal that Chemistry teachers in Morogoro secondary schools are highly aware of digital learning platforms, with 100% acknowledging their value in lesson preparation. However, this awareness does not consistently translate into classroom practice, as nearly half of the students reported that they had never observed teachers using digital tools during lessons. This gap aligns with the Technology Acceptance Model (TAM), which posits that the use of technology depends not only on perceived usefulness but also on perceived ease of use (Davis, 1989). While teachers recognize the benefits of digital platforms for enhancing understanding and engagement, infrastructural challenges such as unreliable internet access, limited devices, and inadequate technical support impede their effective integration. The reliance on easily accessible tools such as YouTube, Shule Direct, TIE, and Mwalimu Plus, with only 20% of teachers using Learning Management Systems (LMS), reflects a tendency to adopt user-friendly platforms over more complex but pedagogically rich systems, confirming Ifenthaler and Yau's (2020) observation that teachers often gravitate toward simpler digital resources. This pattern also reflects the Policy Implementation Theory, which emphasizes the gap between policy intentions and practical execution; although ICT integration is promoted at the national level, schools lack the capacity and resources to implement it fully.

In terms of student outcomes, the study indicates a strong positive effect of digital learning platforms on understanding and applying Chemistry concepts. A majority of students (over 90%) reported that videos, animations, and online quizzes enhanced their comprehension, problem-solving skills, and confidence. These findings resonate with the TPACK framework, which underscores the integration of technology, pedagogy, and content knowledge. Visual simulations and interactive resources facilitated by digital tools help teachers translate abstract Chemistry concepts into more concrete, accessible learning experiences, supporting inquiry-based and experiential learning (Mishra & Koehler, 2006). Similarly, teachers observed increased student engagement, motivation, and collaboration during lessons utilizing digital resources, consistent with findings by Manyilizu (2023), who reported improved performance and deeper understanding among students using virtual laboratories. These outcomes also align with Sappaile et al. (2023) and Smith et al. (2020), which demonstrated that digital learning platforms significantly enhance engagement and academic performance in STEM subjects.

The study also highlights behavioral and pedagogical transformations linked to digital platform integration. Observations indicated that students actively revisited content, collaborated effectively, and demonstrated higher motivation and focus after exposure to digital resources. This supports the empirical literature showing that digital tools facilitate flexible, self-paced, and interactive learning (Lubua, 2023; Maier et al., 2022). Nevertheless, challenges such as digital distractions, inconsistent

application, and low adoption of LMS indicate that the benefits of digital platforms are not uniform. These findings reinforce TAM's assertion that adoption depends on both perceived usefulness and ease of use, and they echo UNESCO (2020) in recognizing that without adequate infrastructure, teacher training, and institutional support, the potential of digital learning tools remains underutilized. Overall, the study suggests that while digital platforms significantly enhance Chemistry learning, systemic support and structured integration are crucial to maximize their impact.

## Conclusion and Recommendations

Based on the study's findings, it is evident that digital learning platforms have considerable potential to enhance students' understanding and application of Chemistry concepts in public secondary schools in Morogoro. The research revealed that while Chemistry teachers are highly aware of these platforms and actively use them during lesson preparation, the actual integration into classroom instruction remains inconsistent. Students' exposure to digital tools is partial, with nearly half reporting that they have never observed such resources in use during lessons. Despite these limitations, the available digital tools, including YouTube educational channels, Shule Direct, TIE, and Mwalimu Plus, were found to support improved conceptual understanding, problem-solving abilities, visualization of abstract phenomena, and learner engagement. Observations further indicated positive behavioral changes among students, including increased collaboration, motivation, curiosity, and attention when digital platforms were incorporated into lessons. The study also highlighted that teachers predominantly rely on accessible resources rather than more sophisticated Learning Management Systems (LMS), pointing to a gap between potential and practical implementation.

The findings underscore the need for systemic support to optimize the benefits of digital learning platforms in Chemistry education. Schools and education authorities should prioritize strengthening infrastructure, including reliable internet connectivity, sufficient digital devices, and projectors, to facilitate active classroom integration. Continuous professional development and structured training programs for teachers are crucial to enhance their confidence and competency in using both basic and advanced digital tools. Additionally, the adoption of Learning Management Systems should be encouraged through awareness campaigns and practical guidance, as these platforms offer organized and interactive learning experiences that can further enhance student outcomes. Beyond infrastructure and training, institutional policies should foster a culture of consistent digital integration in classrooms, ensuring that the perceived value of technology translates into meaningful and sustained educational practice. By addressing these structural, pedagogical, and resource-related challenges, digital learning platforms can be effectively harnessed to improve Chemistry

education, promote active learning, and support the development of STEM competencies among secondary school students in Tanzania.

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